APPRAISAL OF GARDEN CRESS (Lepidium sativum L.) AND PRODUCT DEVELOPMENT AS AN ALL PERSUASIVE AND NUTRITION WORTHY FOOD STUFF

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Abstract
Garden cress has been considered as an important nutritional and medicinal plant in India since the Vedic era (between 500-1700 B.C.). In Ayurveda, the indigenous medicinal system, it is described as hot, bitter, galactogogue and claimed to destroy vata (air) and kapha (phlegm). Seeds are also rich source of omega 3-fatty acids which helps to lower cholesterol in hypercholesterolemic patients. The non conventional food stuff namely garden cress (Lepidium sativum L., family - Cruciferae) was processed and the resultant processed versions were analyzed for proximate principles, minerals and antinutrients. Food product dahiwala bread was developed using processed versions of garden cress seeds. Results showed that garden cress seeds are good source of protein, fat, calcium, iron and phosphorous. Processing (dehusking) procured a significant decrease in oxidale and total cyanogens while phytic acid was reduced to a small extent. Food Product, dahiwala bread, developed keeping in view of its consumption by masses in general, was found in the realm of acceptability by the semi trained panel. Version 1(Whole garden cress seed flour incorporated product) was as acceptable as standard. Thus, the food products developed incorporating garden cress seeds, like the present one could be beneficial for masses as nourishing as well as therapeutic agents due to the presence of various therapeutic properties like hypoglycaemic, hypotensive, fracture healing, anticancerous and the like.

Keywords: Garden cress (Lepidium sativum L.), non-conventional food stuff, minerals, antinutrients, nutraceutical, hypoglycaemic, anticancerous

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1. INTRODUCTION

Plant world is replete with an array of foodstuffs, many of which stood relegated to the margins for a long time owing to their low pellet appeal. However, with the inception and upcoming of the science of Foods and Nutrition, a number of non-conventional food stuffs have been explored, analyzed, processed and used up in the development of food products, all in a bid to end their oblivion on one hand and accruing benefit to the masses on the other. Garden cress (Lepidium sativum L.) is one such food stuff that abounds not only in nutrients but also in health enhancing phytochemicals (Wealth of India, 1962). This has been the reason why tradition, folklore and indigenous medicine, all advocated garden cress for finding succor from one or the other ailment http://www.naturalstandard.com/index-abstract.asp?create-abstract=patient-garden_cress.asp&title=Garden%20cress.

Science of Nutrition has also come of age to imbibe and practice some facts about diets and their health enhancing effects. Whereas earlier reflections on healthy, wholesome diets led to the belief that proteins, vitamins and minerals were the substances that act as protective agents against chronic and degenerative diseases, phytochemicals - the bioactive compounds ubiquitously present in plant based foodstuffs have emerged as the new saviors with potential for prevention and management of such diseases. The plant based foodstuffs loaded with both nutrients and bioactive substances have been accordingly given the name nutraceuticals. In simple terms, nutraceuticals are defined as foods or food products that reportedly provide health benefits that include both prevention and treatment of diseases.

In fact, “Nutraceutical” is a broad umbrella term used to describe any product derived from food sources that provides extra health benefit

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in addition to its basic nutritional value (DeFelice, 1995). The products typically claim to prevent chronic diseases, improve health, delay the aging process, and increase life expectancy. A nutraceutical has a demonstrable physiological benefit or it provides protection against one or the other chronic disease (http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1171305207040). Such products may range from isolated nutrients, dietary supplements and specific diets to genetically engineered foods, herbal products, and processed foods such as cereals, soups, and beverages. Dating back to the Roman times (753 B.C.); garden cress has long been an important source of nutrients for Europian and Asian populations. It was used by the ancient Egyptians as a food source and became well known in various parts of Europe (including Britain, France, Italy & Germany) in due course where it is still used as a minor crop. Persians used to eat this plant even before bread was known(http://www.fao.org/docrep/t0646e/ T0646E0t.htm). It has two types of leaves, long ones at the bottom of the stem and small, bright-green, feather like arranged on opposite side of its stalk at the top. Its growth is very rapid and harvesting can begin in the same month as sowing, with yields reaching as high as 6 tones per hectare. Soil of 6.0-7.5 pH is suitable for this crop. Garden cress can be harvested throughout the year, whether grown indoor or outdoor and is cut when the sprouts are 2-4 inches tall (http://www.natural-healing-uide.com/GardenPharmacy/Cress.htm). Garden cress seeds are thermogenic, depurative, galactogogue, emmenagogue, aphrodisiac and act as a tonic against diarrhea, dyspepsia, eye diseases, leucorrhoea, scurvy, asthma, cough, cold and seminal weakness (http://www.motherherbs.com/lepidium-sativum.html). Seeds are recommended for the dispersion of chronic enlargement of spleen. Powder of garden cress seeds with sugar can also be used to cure diarrhea, indigestion and dysentery (Nadkarni et. al, 1954). A tea spoon full of garden cress seeds boiled in 6 ounces of water for ½ hour and the decoction with a tablespoon of honey is given as an effective medicine to increase breast milk, sexual stamina, and sexual retentivity (Chopra and Nayar, 1956).

2. MATERIAL AND METHODS

Preparation of processed versions
Whole garden cress seed flour (WGCSF): Garden cress seeds were sundried and hand sorted to remove wrinkled, moldy seeds and foreign material and thereafter, ground into fine flour in a mixer and stored.

Dhusked garden cress seed flour (DGCSF): Garden cress seeds were sun dried and hand sorted to remove wrinkled, moldy seeds and foreign material. Then, they were ground in a mixer, equipped with stainless steel blade and stored in an airtight container. This step was followed by sieving WGCSF through muslin cloth. Sieved garden cress seed flour was husk free and stored in another air tight container.

Garden cress seed husk flour (GCSHF): Husk obtained from above process was stored in an air tight container after grinding.

Proximate Principles
The proximate and nutritional parameters evaluated were moisture, crude protein, fat, crude fibre, ash, total carbohydrate, calcium, iron and phosphorous (Raghuramulu et al., 2003; AOAC, 1980; Sharma, 2003). All were analyzed in triplicate sets. Moisture content was determined by drying up the sample in air oven at 100-125°C. Crude protein was carried out using the Kjeldhal procedure with nitrogen to protein factor of 6.25.

Fat was estimated through soxhlet extraction. Fibre was analyzed through resistant to the action of dilute mineral acid (Sulphuric acid) and alkali (Sodium hydroxide) and total carbohydrate was calculated by subtracting from 100, a sum of values (g/100g) for moisture, protein, fat, ash and crude fibre. Calcium, iron and phosphorous was estimated by dry ashing method.
Antinutrients

Phytate (Davies and Reid, 1979)

This method was based on the observation that ferric ions complexed with phytate at pH 1-2 can’t react with thiocyanate ion to give the characteristic pink complex, the extinction at 465 nm in the amyl layer is inversely related to the phytate anion concentration.

Extracted sample with conc. HNO₃ by continuous shaking, filtered and made up to suitable volume with water. To the filtrate, added ferric ammonium sulphate solution, mixed and placed in a boiling water bath. Cooled the contents and added isoamyl alcohol and mixed. To this, added ammonia solution, shaken thoroughly and centrifuged. The alcoholic layer was separated and the colour intensity was read at 465 nm against amyl alcohol blank. Sodium phytate standards were run along with the sample. The results were expressed as mg phytic acid/100 g dry wt.

Oxalate (Raghuramulu et al., 2003)

The oxalic acid was extracted in HCl and precipitated as calcium oxalate by adding calcium chloride which was then washed and titrated with KMnO₄ in the presence of dilute H₂SO₄. 1 ml of N/20 KMnO₄ is equivalent to 0.00225 g of oxalic acid.

Weighed sample in a volumetric flask, added H₂O and 6N HCl and digested on boiling water bath. The suitable volume was made after cooling and filtered the supernatant. Then took filtrate and added 6N HCl. Evaporated the mixture to half of its volume and filtered. Washed the precipitate to make suitable volume. Thereafter, added 3-4 drops of methyl red followed by concentrated NH₃, till the solution turned faint yellow, heated, allowed to cool at room temperature and filtered. Thereafter, boiled the filtrate, added CaCl₂, with constant stirring and allowed to stand overnight. Following day filtered it through Whatman filter (No. 41) and the precipitate was washed several times with hot water to make it free of Ca ions.

Transferred the precipitate to the original beaker by washing with distilled water. Then added H₂SO₄ solution till the precipitate was completely dissolved. The contents were warmed and titrated with N/20 KMnO₄ to the near end point.

Total cyanogens (Petybridge, 1919; Hogg & Ahlgren, 1942)

Hydrocyanic acid, which was evolved from the sample, forms a red color compound with sodium picrate and the intensity is measured at 625 nm. Homogenized the sample in water with 3-4 drops of chloroform. Placed this homogenate in a conical flask. Saturated the filter paper strips with alkaline picrate solution and placed in hanging position with the help of a cork stopper inside the conical flask. Incubated the mixture at room temperature for 20-24 h. Sodium picrate present in the strips was reduced to reddish compound in proportion to the amount of hydrocyanic acid evolved. Eluted the color by placing the paper in a clear test tube containing 10 ml distilled water and compared it with standard hydrogen cyanide solution at 625 nm.

FOOD PRODUCTS

Standardization and development of recipe

In order to select recipes for the present study, various recipes were explored. The recipes were improvised using information collected from various resources. Each product was developed by incorporating garden cress seed flours at an appropriate level after standardization trials. In general, development of each recipe was based on the following considerations:

1. Easy availability of ingredients, 2. Popular consumption by the masses, 3. Ease in preparation in terms of time, money and energy consumption, 4. Potential for providing calories, protein and important micronutrients, 5. Good palatability and acceptability attributes.

Dahi wala bread at 3% incorporation level was developed. It is an amazing and quick breakfast item (http://www.tarladalal.com/Chatpata-ahiwala-Bread-2876r). Soyabean oil is used so as to incorporate polyunsaturated fatty acids.
and to avoid saturated fats which are conducive to the development of obesity, diabetes and cardiovascular disease. Triangle test was carried out to select the semi trained panel members and the food product was evaluated for acceptability through 9 point hedonic method by the panel of selected semi trained personnel. The product was evaluated for individual sensory attributes viz, appearance, color, texture, taste, flavor, after taste and over all acceptability.

Organoleptic evaluation

Table 1: Incorporation of GCS flours and other ingredients in Dahiwala bread

<table>
<thead>
<tr>
<th>Ingredients (g)</th>
<th>Standard</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Curd</td>
<td>75</td>
<td>72</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>Turmeric</td>
<td>0.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Red chili powder</td>
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<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cumin seeds</td>
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<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Asafoetida</td>
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<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Onion</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Tomato sauce</td>
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<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>GCSF</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Soya bean oil</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* S = Standard (Without incorporation of GCSF in Dahiwala bread), A = WGCSF incorporated Dahiwala bread, B = DGCSF incorporated Dahiwala bread, C = GCSHFB incorporated Dahiwala bread

Statistical analysis

All experiments were carried out in triplicates. Statistical analysis was done using Microsoft Excel 2007. The average values are reported together with standard deviation.

3. RESULTS AND DISCUSSION

Figure 1 shows the proximate composition of all versions of GCSF. The mean moisture content of WGCSF was found to 5.83±0.28 g/100g. Dehusking caused a significant decrease in moisture content, while GCSHFB was reported to have higher moisture content even than that of WGCSF. The mean ash content for WGCSF was 5.93±0.11 g/100g. Dehusked and husk versions were found to have more ash content. The mean protein content of WGCSF was 25.09±0.51 g/100g. Dehusking resulted in increase. GCSHFB was reported to have significantly reduced amount of protein as compared to that of WGCSF. Mean scores of fat content for WGCSF was 21.83±0.28g/100g. Dehusking caused increase and GCSHFB decrease. However both alterations were significant. For WGCSF, DGCSF and GCSHFB, the mean fiber contents were 7.86±0.05, 5.73±0.30 and 15.16±1.51 (g/100g). Significant difference was found only in WGCSF and GCSHFB fibre content. The mean total carbohydrate content for all three samples (WGCSF, DGCSF and GCSHFB) was 33.46±0.63, 29.94±2.82 and 39.46±4.83 (g/100g). There was significant difference of total carbohydrate in GCSHFB vis-à-vis that of WGCSF.

In a study, the author reported that garden cress seeds are rich sources of protein, lipids and total carbohydrates. All essential amino acids except sulphur containing and tryptophan are present in high amounts. Among fatty acids, α-linoleic acid (LA) and oleic acid (OA) were the most abundant fatty acids in the oil of *L. sativum* (Zia-Ul-Haq et al., 2012). Numerous physiological properties have been attributed to LA including action as an antiadipogenic, antidiabetogenic, anticarcinogenic, and antiatherosclerotic agent. In addition, LA has effects on bone formation and the immune system as well as fatty acid and lipid metabolism and gene expression in numerous tissues (Belury & Kempa-Steczko, 1997; Belury and Venden, 1997; Houseknecht et al., 1998; Li & Watkins, 1998; Belury and Vanden, 1999; Park et al., 2000; Eggert et al., 2002). OA has been associated with decreased low-density lipoprotein (LDL) cholesterol, and possibly increased high-density lipoprotein (HDL) cholesterol. Oleic acid may be responsible for the hypotensive (blood pressure reducing) effects of olive oil (Teres et al., 2008). Garden cress seeds are found to be rich source of iron, calcium and phosphorous. Iron is needed for a number of highly complex
processes that continuously take place at the molecular level in the human beings, e.g. the transport of oxygen in the body. Iron is required for the production of red blood cells (a process known as haematopoiesis) and binds to the oxygen and thus facilitates its transport from the lungs via the blood vessels to all cells throughout the body. Iron is also involved in the conversion of blood sugar to energy.

Metabolic energy is crucial for athletes since it allows muscles to work at their optimum during exercise or on a competition. Other minerals are also of paramount importance as calcium along with phosphorous is needed for bones and other vital functions in the body. Garden cress seeds are found rich source of calcium and phosphorous (Zia-Ul-Haq et al., 2012). Gokavi et al. (2004) reported that calcium and phosphorous content were good in GCS. While Gopalan et al. (2003) also found GCS as rich source of iron, calcium and phosphorous. Our iron and calcium contents are in agreement with those of Gopalan et al. (2003), while phosphorous content is near to that of Gokavi et al. (2004) Difference could be because of variety and agronomical conditions.

Dehusking caused significant increase in iron and phosphorous and decrease in calcium contents. This process is also beneficial as it seemed to have the positive effect on minerals. Phosphorous is of paramount importance as it is a component of nucleic acids which are responsible for storage and transmission of genetic material. Combined with lipids, it is an important structural component of cell membranes. It has low sodium and high potassium content which makes it beneficial as an ingredient in health foods. High potassium diet is recommended for athletes who are involved in hard exercise and also for disorders related to high blood pressure (Gokavi et al., 2004; Luft, 1987). Gokavi et al. (2004) reported that dehusking resulted in significant decrease in calcium content of endosperm and increase in bran respectively. Iron content was found highest in endosperm and least in bran. Similar trend was found in phosphorous content i.e. highest in endosperm and least in bran portion. Our result is in agreement with this study. According to Abiodun and Adepeju (2011), dehulling caused significant decrease in iron, calcium and phosphorous contents of bambara nut (Vigna subterranea L. Verde) flour. Iron value is contradictory to this study result, could be because of change in adoption of sieving method. WGCSF was found to have tannins, phytic acid, oxalic acid and total cyanogens as 51.00±1.00, 0.77±0.11, 135.66±2.08 and 5.50±0.10 (mg/100g). Oxalate, phytate and tannins are anti-nutrients, which could be toxic when consumed in an unprocessed food (Ojiako and Igwe, 2008). The bioavailability of the essential nutrients in plant foods could be reduced by the presence of anti-nutritional factors such as oxalates and cyanogenic glycosides (Akindahunsi and Salawu, 2005).
of *Lepidium sativum* was found as 0.5-1.0 (mg/g).

![Figure 3. Mean content values of antinutrients for processed versions of GCS.](image)

Hussain et al., (2011) found 0.61% tannins in *Lepidium sativum*. According to Matthaus (2005), tannins and phytic acid content was 19.6 mg/g and 18 mg/g respectively. Our result is in agreement with those of Hanif et al. (2008). Difference in other authors’ reports could be because of difference in variety and procedure of extraction of husk. Dehusking resulted in significant decrease in oxalic acid and total cyanogenes. Phytic acid was also reduced but decrease was non-significant.

![Figure 4. Hedonic acceptability evaluation scores of S and processed versions for Dahiwala bread.](image)

Result of this study supports the fact that processing enhances the absorption of minerals and improves the protein digestibility along with preventing one to suffer from GIT and other problems as phytate forms complexes with proteins & starch resulting in inhibition of their digestion. According to Abiodun and Adepeju (2011), dehulling caused significant decrease in phytate and oxalates of bambara nut (*Vigna subterranea* L.) flour. Our result is in line with that of this report. Dahiwala bread at 3% incorporation level was developed for elderly people. Version 1 was equally liked as standard while other versions (2 and 3) were having significant differences on comparing with standard. But they were also liked and in the range of “liked slightly to moderately”.

4. CONCLUSIONS

Garden cress seeds are rich source of protein, fat, iron, calcium and phosphorous. Processing through dehusking changed antinutrient levels without much erosion in nourishability. In this way garden cress seeds, after being processed through as simple as dehusking could become helpful in preventing and curing various diseases like PEM, anaemia, osteoporosis, osteomalacia and bone fracture through long term consumption as a food stuff of nutraceuticals nature. Incorporation of garden cress seeds into food products like *dahiwala bread* developed here, could benefit all age group individuals for nourishment and those at risk or suffering from anaemia, fractures and diabetes mellitus, and the other chronic degenerative diseases to pursue prevention and management of these diseases.

5. ACKNOWLEDGMENT

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6. REFERENCES


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